# MEASURING PROFITABILITY IN SMALL SCALE AQUACULTURE ENTERPRISES IN SOUTH WEST NIGERIA

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## ABSTRACT

Aquaculture, the farming of aquatic organisms especially fish, in Nigeria is dated back to the 1940s at Onikan Experimental farm, South West Lagos and the 160ha industrial scale fish farm, Middle Belt, Panyam, Jos in 1951. Since then, great expansion has been witnessed in Nigeria's aquaculture industry; graduating from extensive practice to super-intensive systems. This is evidenced by the use of concrete and plastic tanks as flow-through and re-circulating systems in boosting fish production in a small space as compared to extensive system utilizing earthen pond facility. The advent of extruded floating feed compared to supplementary and sinking feed are all indications of Nigeria aquaculture industry expansion. Despite this advancement, the industry contributes only 20% to Nigeria local fish production. Researchers, policy makers and donors are still doubtful about the potential of aquaculture to contribute to sustainable rural livelihoods in Nigeria. This paper presents the results of the study carried out to investigate the profitability of aquaculture enterprises in South West Nigeria. 40 randomly selected fish farms were visited, and data were collected based on their production operations. The study focussed on measures based on classical techniques which examined returns to resources used, benefit/cost ratios, welfare contribution to households/society, improvement to rural livelihoods and value addition. We use past and current records of net returns above costs and a cost of living allowance to evaluate the economic and financial sustainability of the farms in the study area. The results show that only 25% were profitably operated, while 75% were not.

## INTRODUCTION

The global economic outlook for aquaculture over the next twenty years is exceptionally positive. The world's harvest fishery production has peaked and the increase in demand for fish products is being met by a growth in aquaculture production. More than 700 million people depend on aquatic agricultural systems for their livelihoods. These are diverse farming systems that include a mix of cultivation, livestock, and aquaculture, fishing, and gathering natural resources such as fruits, seeds, timber and wildlife. However, there are many constraints that prevent low income smallholders from fully benefitting from these naturally productive systems. The important role of fisheries in the African agricultural sector is highlighted by the fact that approximately 10 million Africans derive their livelihood from the fishing industry and are employed in different entry points of the fishing value chain. Africa's contribution to global trade in fish and fish products generates local revenues of up to US$4.5 billion for African economies (WorldfishCentre, 2011). Aquaculture is a management-intensive business. The need for intensive and skilled management stems from the high level of capital invested in the facilities, and in the high levels of operating capital required to operate a competitive and profitable business. Commercial aquaculture (farming operations of aquatic organisms) seeks to maximize profits (business-oriented) especially by the private sector. The majority of aquaculture businesses require substantial amounts of both operating and investment capital. One of the largest problems encountered in starting an aquaculture business often is to acquire sufficient capital. The aquaculture industry has great potential to meet the increasing demand for aquatic food in most regions of the world. However, in order to achieve this, the sector (fisheries organisations, governments and farmers) may face significant challenges because of (a)Economic and bio-technical constraints exist, and the transition from non-commercial to commercial fish farming is not common (b) Fingerling availability, quality and distribution remain a serious constraint to non-commercial and commercial aquaculture development in all countries however this also presents unique business opportunities and (c) feed availability, quality of seed, distribution of fingerlings and acceptable food conversion ratios remain major constraints to both non-commercial and commercial producers. Most non-commercial farmers use protein limiting diets, the use of farm made feeds is increasing slowly, while manufactured feeds are generally of a low quality.

High quality extruded feeds are only manufactured in South Africa (Machena and Moehl 2001). In Nigeria, aquaculture is promoted for its potential contribution to food security, directly by producing food fish and other products, and indirectly through employment creation and generation of income for the purchase of food. However, the growth of Nigerian aquaculture will be determined by the extent and nature of support measures provided by the government and the public sector to remove constraints to development, especially in the areas of financial sustainability. At present, aquaculture in Nigeria is characteristically done for domestic consumption, adopting low investment and low technology, thus the returns are somewhat very low pond production. The ponds are small in size with a production output hardly exceeding 0.35 kg/m2 year-1. Most of these ponds are for extensive fish production. This paper investigates the profitability of small-scale aquaculture enterprises in South West Nigeria, with the main objective of identifying the economic and financial sustainability of the farms in the study area. An enterprise budget provides a generalized snapshot of the costs and returns of a particular enterprise—in this case production—for a particular period of time. In line with the observation of Hishamunda, (1993), estimated costs and returns to farm enterprises helps producers examine their operations and evaluate the profitability of each enterprise.

## METHODOLOGY

### Description of study area

This study was conducted in April 2009 – May 2010 in 40 randomly selected small-scale fish farms in South West Nigeria. The choice of these farms was purposive and based on the following reasons: First, a number of small-scale fish farming projects have been operating in these areas for many years. Secondly, over 90% of the farmers are not scientifically/ economically equipped to operate under any fiscal/ budgetary policy. Thirdly, low income and animal protein intake, both of which characterize the South West states of Nigeria, increases the need to continue and intensify fish farming. In addition, there is relatively limited published information on the economics of fish farming in most of the existing farms.

Data were collected based on their production operations. The interviews, lasting about two to three hours, solicited information on number of years in the aquaculture business, types of operation, species cultured, product forms, marketing strategies and income generated from aquaculture. Other information collected included: characteristics of the farmer, production cycle, credit accessibility, group linkages, record keeping and access to extension services.

A one pond production model was developed based on the data collected from the farmers. Such data include stocking density, management costs, feeds, liming, fertilizer, harvesting cost and labour. Interviews were also conducted with farmers to identified constraints to the development of commercial aquaculture, information about markets and policies that could encourage the development of aquaculture. The instruments used for data collection were a structured questionnaire, Participatory Rural Appraisal (PRA) and Researchers' observation conducted in each of the farms. The questionnaire was prepared to solicit information on the costs and returns of fish farming as an enterprise. No rigorous economic model was utilized based on the small-scale operation methods of production used by the farmers. The first step in the analysis of the economics of fish farming was to determine if it is possible to make money generally from this type of business activity.

For this, the method called enterprise budget analysis was performed. In this study a survival rate was 90% for all a complete cycle was assumed. A simple profit/loss calculation was used to determine profitability of the system. Data analysis was conducted with Statistical Package for Social Sciences (SPSSx) computer programmes. Mean percentage was produced to validate each research question. **TVC** consist of costs of fish seed (fingerlings/ juveniles), lime, fertilizer, fish feeds, hired labour, medication, fuel, transportation, and miscellaneous.

Gross Revenue **(GR)** consists of receipts from total sales. It is the product of quantity harvested for sales and unit market price of fish per kilogram.

Gross Revenue = Quantity Harvested (kg) X Unit Market Price

**Net Profit** This was determined by deducting total cost of production (TC) from the gross revenue (GR)

Net Profit = Gross Revenue – Total Costs

Rate of Return on Investment (**RRI**) was determined by dividing net returns by total cost of production

Rate of Return on Investment = Net Returns/ Total Costs

## RESULTS AND DISCUSSION

### *Socio-economic characteristics*

The average age of the fish farmer is 43.5 years, with 55.5% between 36 and 45 years age category, and 27.5% in 16-35 years category. About 36.2% of the fish farmers are male with average of about 12 years of formal education, however the business is male dominated, with 75 per cent of the respondents being men. This may not be unconnected with the 42.5% of the sampled farmers had 5 ponds in their farms, with an average size of 0.58 hac. None of the respondents had access to bank credit; about 25 per cent sourced credit from cooperatives and 45 per cent sourced from personal savings. This finding is in line with Ikotun, (2002) who sampled fish farmers in Oyo State where only 5 per cent of the sampled fish farmers had access to bank credit while 73.2 per cent used personal savings. Table 1 shows some of the socio-economic profile of the fish farmers in the study area.

**Table 1: Some socio-economic profile of the fish farmers**

| Characteristics | Percent, N=20 | Mean/Mode | Standard deviation | Minimum | Maximum |
|---|---|---|---|---|---|
| Age (years) | | | | | |
| Less than 15 | 0.6 | | | | |
| 16-35 | 30.5 | | | | |
| 36-45 | 55.5 | 43.5 years | 12.78 | 13 | 72 |
| 46-60 | 8.3 | | | | |
| Above 60 | 5.1 | | | | |
| Education (years) | | | | | |
| None | 30.6 | | | | |
| Less than 6 | 7.4 | 5.7 years | 4.66 | 0 | 24 |
| 7-12 | 36.2 | | | | |
| More than 12 | 25.8 | | | | |
| **No of ponds** | | | | | |
| 1. Three | 2.1 | | | | |
| 2. Four | 5.8 | | | | |
| 3. Five | 42.1 | 0.58hac | 1.67 | 1 | 5 |
| 4. Six | 35.8 | | | | |
| 5. More than six | 17.9 | | | | |
| Family size (persons) | | | | | |
| Less than 2 | 8.3 | | | | |
| 3-5 | 20.7 | 8 persons | 7.3 | 1 | 15 |
| 6-9 | 34.4 | | | | |
| 10-12 | 36.6 | | | | |
| Income per annum, (N) | | | | | |
| Less than N50,000 | 3.4 | | | | |
| N50,000- 150,000 | 10.6 | | | | |
| N150,000-200,000 | 20.5 | | | | |
| N200,000-250,000 | 27.8 | N256,000 per annum | n.a | 45,000 | 458,000 |

### *Fish farm management*

Tables 2 and 3 show some of the results of the farm management options and the estimated average cost for one cycle for the small scale farm operations in the study area. The result shows that over 42% of total cost is expended on feeds and feeding ingredients, while about 45.3% is used to cover stocking of fish feeds yearly. Variable inputs such as stocking, feeding and pond maintenance constitute the major factors of production in all the fish farms. Depending on the experience of the fish farmer, production (culture) period ranges from 4 to 6 months, while the period of returns to investment could be as short as 4 months. Over 40% of the fish farms operate on monoculture of the African catfish (*Clarias gariepinus* and 40%, Hybrid catfish (*Heteroclarias)* while 20% engage in the polyculture of both *C. gariepinus* and *Tilapia.* 45% of the farmers had a 3-cycle production regime, with a mean profit of N256,000 per cycle; 35%, 2-cycle, mean profit of N358,000 per cycle and 20% non-defined production cycle, with a mean profit of N313,000.00 per cycle.

**Table 2. Fish farm management options of the study area**

| Management options | Frequency | Percentage |
|---|---|---|
| **Types of pond** | | |
| Earthen | 18 | 35 |
| Concrete | 25 | 55 |
| Diversion | 5 | 10 |
| **Level of Management** | | |
| Intensive | 5 | 10 |
| Extensive | 20 | 50 |
| Semi-intensive | 17 | 40 |
| **Culture practice** | | |
| Integrated | 5 | 10 |
| Monoculture | 35 | 70 |
| Polyculture | 10 | 20 |
| **Species cultured** | | |
| Hybrid catfish / C gariepinus spp | 17 | 40 |
| Clarias spp | 17 | 40 |
| Others ( Hybrid Clarias with Tilapia | 10 | 20 |
| **Cycle of production** | | |
| 1-cycle | 5 | 2 |
| 2-cycle | 24 | 53 |
| 3-cycle | 18 | 45 |

Table 2 shows that 55% of the sampled fish farmers raised their fish in concrete tanks of various dimensions. The remaining 35% used earthen ponds. Based on the level of management, 50% of the respondents practised extensive pond management system. This means that the mode of feeding is based on the farmers' reliability on available natural feeds in the water. However 40% of the respondents supplement the fish feeds with addition provision of formulated feeds (semi-intensive). 10% of the farmers fed their fish solely with compounded feeds purchased from commercial fish feed providers. This percentage is very small due to the high cost of feed ingredients. The fish species cultured are either pure *Clarias gariepinus*, hybrid *Clarias* or a mixture of the two strains of Catfish. The results show that 40% of the respondents culture Hybrid catfish mixed with pure strains of C. *gariepinus*, while 40% culture pure strains of *C. gariepinus* and 20% mixed their stocked Clarias spp with Tilapia. Catfish is largely cultured because of the high preference and good marketability, resistant to harsh environmental condition and can survival even in running and stagnant water. The cycle of production varies from one farmer to another. The results show that the highest number of farmers practised 2-cycle production time. That means that 53% of the farmers produced fish twice in a year, with 5-6 months being the culture period. 45% of the farmers raised their fish three times in year, with 3-5 months culture period.

***Costs and returns***

Attempts were made to estimate the cost and return from fish farming exercise using average cost of both costs expended and the yield or output data recorded by each of the respondent in a production cycle. The cost and return analysis in table 3. It reveals the cost of fish fingerlings accounted for the largest proportion (45.3%) of the cost of fish farming in the study area. This is followed by cost of fish feeds (42.0%). This shows that large amount of money was spent by fish farmers for the purchase of feeds and fingerlings. This finding is in agreement with Louise (1977) who said that the cost of feeds was very high in catfish production and Okwu and Acheneje (2011) who also recorded fish feed and fingerlings as the two farming components that eat deep into the farmers variable costs. Operating costs include fixed costs and variable costs. Fixed costs are associated with the long-term operation of a catfish farm. Examples include: taxes (on property), insurance, depreciation, interest, amortization payments (for repayment of borrowed money). These costs are not recorded in this study. Over 85% of the farmers did not keep any records of fixed costs. However only the cost of land and the few available structures were estimated as presented in table 3. These amounted to N290, 000.00. The variable costs vary with the size of the sampled farm and the number of ponds stocked. These include fish fingerlings, fish feeds and labour. Returns include the money that the farmer receives from the sale of his stocked fish. Profit is the most important return and this was determined by subtracting the costs of production from the amount received when the stock is sold.

**Table 3. Estimated average costs (1 cycle) for small scale fish farms in the study area**

| Cost type | Average cost (Naira) | Percentage |
|---|---|---|
| ***Variable Cost*** | | |
| Fish fingerlings | 135,000 | 45.3 |
| Feeds | 125,000 | 42.0 |
| Labour (production) | 12,000 | 4.0 |
| Labour (harvesting) | 7,000 | 2.4 |
| Net purchase | 8,500 | 2.9 |
| Net rental | 2,500 | 0.8 |
| Transportation | 7,500 | 2.6 |
| Total variable costs (TVC) | **297,500** | |
| ***Total fixed costs (TFC)*** | | |
| Land & Available Structures | **290,000** | |
| Grand Total costs (TVC+TFC) | **587,500.00** | |
| **Revenue** | | |
| Number of fingerlings stocked | 9000@ N15.00 | |
| Mortality @ 35% | 3150 | |
| Production cycle (months) | 4-6 | |
| Price of a unit of fish (N/kg) | N350.00 | |
| Sales from harvested fish per cycle | **N1, 102, 500.00** | |

The main assumptions used in the development of the production cycle of the sampled farmers are presented in Table 4. It was observed that most of the farmers did not have sufficient data for a comprehensive data analysis; the assumptions were used with maximum caution.

**Table 4: The main assumptions used in the development of a production schedule**

| Characteristics | Values |
|---|---|
| Stocking density | 5 catfish/m2 |
| Initial weight of catfish stocked | 15 g |
| Cost of catfish fingerlings | N15 / per fingerling |
| Survival at harvest | 55% |
| Cycle length | ± 6 months |
| Harvest weight | 685 g |
| Catfish price | N350/kg |

**Viability of Fish Farming in the Study Area**

The profitability result for the small-scale aquaculture farms in the study area is presented in Table 5. The total costs (Total variable cost and Total fixed costs) amounted to N587, 500.00, while the total revenue was N1, 102,500.00. Other usual variable costs such lime, fertilizer, medication, fuel, transportation were not accounted for in most of the sampled fish farms. The computed Net Farm Income (NFI) was N615, 000, while the Net return on Investment was 1.05. According to Olukosi and Erhabor (1989), net farm income gives an overall level of profitability of an enterprise by putting both fixed and variable costs into consideration and subtracting the cost from the total revenue. The analysis in table 4 reveals that the benefit cost ratio is above one emphasizing the profitability of fish farming in the study area. This result shows that fish farming as a business in the study area is viable since BCR is greater than one. The finding in this study is very low compared with that of Emokaro and Ekunwe (2009) who examined the efficiency of resource-use among catfish farmers to be viable. The rate of returns, 1.05 implies that for every one naira invested, N 1.05 was gained. This is not profitable enough. The results show that only 25% were profitably operated, while 75% were not.

**Table 5. Profitability results for small-scale aquaculture farms in the study area**

| Variable | Nigeria Naira (1$US= 160N) |
|---|---|
| Total costs (TVC+TFC) | 587,500 |
| Total revenue (TR) | 1,102,500 |
| Gross margin (TR-TVC) | 805,000 |
| Net farm income NFI (GM-TFC) | 615,000 |
| Net return on investment (NFI/TC) | 1.05 |

**Welfare contribution to Households/Society**

According to the findings of USAID Markets Programme (2010) the welfare contribution of aquaculture is improving in Nigeria. This study confirms this assertion as follow: 'A well-organized farmer or investor can enter fish farming and establish a farm enterprise to help reduce risk by diversifying the variety of on-farm activities. This offers a farmer an option to start small and "test the waters", then, when the business of fish farming is understood and some degree of success has been achieved, the activity can be expanded with more investment and production. The best fish farmers start small and live at the farm and are "hands on" managers who learn to understand the husbandry of fish in water, which is very different from terrestrial farming of animals or crops'. Available data from this study could not confirm the quantity of harvested fish that were diverted for household consumption and other products given as *gratis* to members of the communities or friends. However the oversight benefits of having some of these fish farms in the communities include: (a) extension of power lines (electricity poles) to some farm locations thereby providing source of power to the villagers and rural dwellers in such area; (b) improvement on the values of some rural roads through local government assistance (rural road improvement) to 3 of such farms (clearing and grading); (c) provision of bore holes to supply potable water to some communities when the fish farms were situated and (d) engagement of some rural populace (especially, youths) in some fish farming activities. The employment/job force of over 10% of sampled fish farms shows an average of 15 people on the farm.

**Improvement to rural livelihoods and value addition**

The benefits to food security - both through increases in income and direct consumption of fish – are clear, but they accrue to relatively small numbers of people. Total production of farmed fish is still only a small fraction of total supply in Malawi, and in all other African countries apart from Egypt (Allison, 2011). And the numbers of farmers with ponds is a minute fraction of the number of smallholder farmers in Africa. Growth of the sector continues to be limited by the water and other resource constraints of small-scale farmers and by weak input and output markets and limited access to technologies and knowledge. Small-scale fish farming in Nigeria should be viewed as a means to improve food security. Many farmers in the study area try to find cheaper feeds as this represents a considerable chunk of operating costs as revealed from the results of this study. Some imported feeds are losing favour as farmers are taking more seriously use of locally manufactured, high quality, fish feeds.

**Constraints/problem Faced by Fish Farmers in the Study Area**

The survey revealed that there are many constraints hindering efficient production of fish by the farmers. The two most serious problems in the study area were high price of fish feeds and high mortality of stocked fish (Table 5). 95% of the respondents opined that the acute shortage of fry and fingerlings was a major problem when they want to re-stock their ponds after each cycle of production. 85% of the farmers complained of lack of skilled workers needed for daily production routine and lack of capital needed for expansion of the business. This result agrees with that of Lawal (2002) and Okwu and Achenje (2011)

**Table 5: Constraints and problems faced by the respondents in the study area**

| Problem | Frequency* | Percentage |
|---|---|---|
| Shortage of fry/fingerlings | 39 | 95 |
| High mortality of stocked fish | 40 | 100 |
| High price of feeds | 40 | 100 |
| Unavailability of adequate funds | 36 | 80 |
| Lack of skilled workers | 37 | 85 |
| Lack of capital/credit | 37 | 85 |
| Lack of good water for fish farming | 29 | 45 |
| Marketing problems | 30 | 50 |
| Lack of extension agents | 35 | 75 |

Multiple response*

## CONCLUDING REMARKS

Available data shows that fish production from aquaculture sector ranges from 15,840 metric tonnes in 1991 to 25,720 MT in the year 2000 and increased to 86,350 MT in 2009 (FDF, 2010). There still exists evidence that substantial part of fish production from home stead farms, rural aquaculture and small scale fish farms that are scattered all over the different states of Nigeria are not backed up by reputable data farming documentations (Akinrotimi *et al.,* 2007). From the observation of Anetekhai, *et al* (2004), aquaculture production varies from 0.5mt/ha in small scale to as much as 10mt/ha in large scale for earthen ponds and this depends largely on the various levels of management. To increase production, Nigerian fish farmers will have to among other options, (a) produce whatever they are best qualified to do under the principle of comparative advantage; (b) purchase their fingerlings from a well-equipped hatchery which has quality brood stock of known source, and (c) source and purchase fish feeds from the best locally available feed mill. Over 85% of small scale fish farmers were found not be good keepers of record. It was also observed that 10% of the sampled farmers feed their stock solely on imported and/ or commercial fish feed, 40% practised semi-intensive culture while 50% were extensive. Most unfortunately, their financial records were half-hazardly prepared. If well practised with passion and devotion, small-scale fish culture can improve rural development. With only 45% of the farmers having access to loans and cooperative scheme, the federal government and her agencies need to improve on the drive to eradicate poverty and famine in the country. The need for extension and advisory services to the farmers is very apt and should be intensified.

## REFERENCES


Akinrotimi, O.A., Onunkwo, D.N. Cliffe, P.T. Anyanwu, P.E. and Orokotan, O.O. (2007a). The Role of fish in nutrition and livelihoods of families in Niger Delta, Nigeria. *International Journal of Tropical Agriculture and food systems* 1(4):344-351.

Allison, E H (2011) Aquaculture, Fisheries poverty and Food security. Working Paper 2011-65.The WorlfFish Centre, Penang, Malaysia.62 pp

Anetekai, M.A., Akin-Oriola, G.A. Adrinola O.J. and Akinola, S.L. (2004). Step ahead for aquaculture development in Sub-Saharan Africa – the case of Nigeria. *Aquaculture* 239:237 – 248.

FDF (2008). Federal Department of Fisheries, Fisheries Statistics of Nigeria Projected human population; fish demand and supply in Nigeria, 2000 – 2015 56pp.

Emokaro, C O and Ekunwe, P A (2009) Profitability and viability of catfish farming in Kogi State, Nigeria. Research Journal of Agricultural and Biological Sciences, 6(3): 215-219

Hishamunda, **N.** 1993. Economic Analysis of Small-Scale Fish Culture in Rwanda: a Comparative Study. Master's Thesis. Auburn University, Auburn, Alabama, 240 pp.

Lawal W.L, 2002. The Economics of Fish Culture in Benue State. Ph. D Thesis. University of Agriculture, Makurdi, Nigeria.

Louise, V R 1977 Fish farming International Unit of Aquatic pathobiology. University of Stirling, Scotland, 4: 17-19.

Machena, C. and Moehl, J. 2001. African Aquaculture: A Regional Summary with emphasis on Sub-Saharan Africa African Aquaculture. March, 2001

Okechi, J K 2004. Profitability assessment: a case study of African Catfish *(Clarias gariepinus)* farming in the Lake Victoria basin, Kenya. Final Project report submitted to The United Nations University, Iceland. 70pp

Okwu, O J and Acheneje, S (2011) Socio-economic analysis of fish farming in Makurdi Local Government area, Benue State, Nigeria. European Journal of Social Sciences, Vol 23 No 4: 508-519

Olukosi, J O and Erhabor, P O (1989) Introduction to farm management economics: Principle and Application. Publ.Ltd. Zaria Nigeria

Ridler, N. & Hishamunda, N. 2001. Promotion of Sustainable Commercial Aquaculture in sub-Saharan Africa, Volume 1. Policy Framework. FAO Rome 2001, 67 pp.

USAID Markets Programme (2010)